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Methane emissions from wetlands and its role on the global methane budget over the last millenium

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More than methane (CH_4) atmospheric concentration, the contribution of each source to the global budget does present strong variations with time over the last millennium. This is proved by large variations in ice-core record of stable carbon isotope measurements in atmospheric CH_4 ($\delta^{13}CH_4$) [Etheridge et al., 1998; MacFarling Meure et al., 2006]. Uncertainties remain about how to explain these observed variations and two major hypotheses have been put forward to explain the measurements [Ferretti et al., 2005; Houweling, 2008]. Even if these hypotheses are based mainly on the role played by biomass burning and anthropogenic sources emergence, they also suggest a decrease in natural sources during the Little Ice Age (LIA) but at different magnitude [Houweling et al., 2008]. Thus better constraint on CH_4 emissions from wetlands during the LIA could help us to choose among these hypotheses and to better understand the global CH_4 budget over the last millenium.

Here, we present results of a modelling approach over the 800-1800 period using the ORCHIDEE model [Krinner et al., 2005] accounting for CH_4 emissions by wetlands. The TOPMODEL approach [Beven and Kirkby, 1979; Decharme and Douville, 2006] and a modification of the process-based model by Walter et al. [2001] are included in ORCHIDEE to compute the wetland dynamic and related CH_4 fluxes [Ringeval et al., submitted]. The model was forced with climate fields from a last millennium simulation performed with the IPSL-CM4 coupled ocean-atmosphere general circulation model.

The simulated CH_4 wetland emissions for key periods (Medieval Warm Optimum and LIA) are then transported in the atmosphere with LMDz-INCA, a global three-dimensional chemistry-climate model [Hauglustaine et al., 2004]. Emissions of volatile organic compounds computed by ORCHIDEE [Lathiere et al., 2005] are also provided to LMDz-INCA as well as mean 800-1800 estimates of other sources. This allows us to estimate the relative roles of wetland emissions vs. atmospheric chemistry in controlling the changes in CH_4 concentration during the last millennium.